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Floristic survey of Algae in Vikramsila Gangetic Dolphin Sanctuary, Bihar (India)

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भारत के विक्रमशिला गंगा डाल्फिन अभयारण्य, बिहार में शैवालों का वानस्पतिक सर्वेक्षण

सुदिप्ता कुमार दास एवं ओंकार नाथ मौर्य

सारांश

विक्रमशिला गंगा डाल्फिन अभयारण्य (बिहार) के शैवाल वनस्पतिजात को 65 जातियों जिनमें 13 जातियाँ सायनोफायसी के 11 वंशों की, 24 जाातियाँ क्लोरोफायसी के 15 वंशों की, 21 जाातियाँ बेसिलेरियोफायसी के 16 वंशों की, 5 जातियाँ यूग्लिनोफायसी के 1 वंश की एवं डिनोफायसी एवं जैन्थोफायसी की क्रमशः एक–एक जाति को यहाँ से प्रथम बार प्रलेखित किया गया है। शैवालों की 6 जातियाँ जिनमें *एफानोकैप्सा इंर्सटा* (लेम्मेरम.) कोर्नबर्ग एवं कोमारेक, *क्रोकोक्कोप्सिस इपीफाइटिका* गेट्लर, *कोरमेरियम आर्नेटम* रालफ्स एक्स रालफ्स, *यूऐस्ट्रम वेरूकोससम* इरेन्ब. एक्स रालफ्स प्रभेद *रिडूक्टम* नोर्डस्ट., *नेविकुला पेरिटिना* कुट्ज. एवं *इंटोमोनिस एल्टाटा* (इरेन्ब.) इरेन्ब, भारत के लिये नवीन वितरणपरक अभिलेख हैं।

ABSTRACT

Algal flora of Vikramsila Gangetic Dolphin Sanctuary (Bihar) is documented for the first time with a record of sixty five taxa including 13 taxa of Cyanophyceae of 11 genera, 24 taxa of Chlorophyceae of 15 genera, 21 taxa of Bacillariophyceae of 16 genera, 5 taxa of Euglenophyceae of 1 genus and one taxon each under Dinophyceae and Xanthophyceae. Six algal taxa, e.g. *Aphanocapsa incerta* (Lemmerm.) Cornberg & Komárek, *Chroococcopsis epiphytica* Geitler, *Cosmarium ornatum* Ralfs ex Ralfs, *Euastrum verrucosum* Ehrenb. ex Ralfs var. *reductum* Nordst., *Navicula parietina* Kütz. and *Entomoneis alata* (Ehrenb.) Ehrenb. are new distributional records from India.

Keywords: Algae, Vikramsila Gangetic Dolphin Sanctuary, Bihar

INTRODUCTION

Vikramsila Gangetic Dolphin Sanctuary is a 60 kms stretch of the Ganges River between Sultanganj to Kahalgaon under the authority conferred in the Wildlife Protection Act of 1972 by the Government of Bihar in August 1991 established specifically for the protection of Gangetic dolphin (*Platanista gangetica gangetica* Roxb.), the national aquatic animal of India. This obligate freshwater dolphin is categorized as endangered since 2004, and recorded in the IUCN Red List due to decline in both its range and population size (Smith and Braulik 2012). The biota of this protected area is under the impact of severe anthropogenic activities like farming, fishing and pollution due to motorized river traffic.

The wetland flora of the locality is dominated by plants belonging to families like Cyperaceae, Poaceae and many other monocotyledons which are yet to be explored. The only record is of Haines (1921-25), who made casual references to the plants of this area. On phycological

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perspective, the localities near by though surveyed from time to time (Singh and Saha 1982a, 1982b; Saha 1985, 1986; Saha and Pandit 1986, 1987; Saha and Wuzek 1989; Kumar and Saha 1993; Kargupta and Jha 2004), this pretected area has not yet been explored. Thus, algal samples from various localities of the protected area was sampled and documented for the first time. A total of sixty five algal taxa belonging to class Cyanophyceae, Chlorophyceae, Euglenophyceae, Dinophyceae, Xanthophyceae and Bacillariophyceae were recorded. Out of these six algal taxa were reported as new distributional records from India.

MATERIALS AND METHODS

Vikramshila Gangetic Dolphin Sanctuary is located between Sultanganj (25° 25′ N 86° 73′ E) and Kahalgaon (25° 28′ N 87° 22′ E) of Bihar (Fig. 1). The Gangetic stretch has the water depth ranging from 0.2 – 40 m and the riverine width varies between 150 m to 3.0 km. The water temperature varies from 5 – 8 °C in winter to 45 °C in summer. The algal samples were collected from 8 different sites, viz. Jagatpur north (25° 20.261′ N; 87° 02.493′E), Jagatpur north-west (25° 20.329′ N; 87° 02.221′ E), Jagatpur south-west (25° 20.314′ N; 87° 02.237′ E), Jagatpur south (25° 18.296′ N; 87° 01.365′ E), Sultanganj (25° 14.599′ N; 86° 46.393′ E), Sultanganj ghat (25° 15.270′ N; 86° 45.109′ E), Nathnagar, near Bhagalpur (25° 14.086′ N; 86° 49.239′ E) and Kahalgaon (25° 16.103′ N; 87° 14.010′ E) during December, 2014 (Fig. 2). The samples were preserved with 4% formaldehyde solution and deposited in Central National Herbarium of Botanical Survey of India, Howrah (CAL). Microscopic observations and morphological studies were made with Nikon microscope Ni-11 fitted with Nikon Digital Camera DS-Ri1-U3 and operated by Nikon Imaging Software NIS-D+EDF. Identification and distributional study of the algae was made following standard literatures.

RESULTS AND DISCUSSION

A total of sixty five algal taxa belonging to class Cyanophyceae, Chlorophyceae, Euglenophyceae, Dinophyceae, Xanthophyceae and Bacillariophyceae, were recorded. These include 13 taxa of Cyanophyceae of 11 genera,

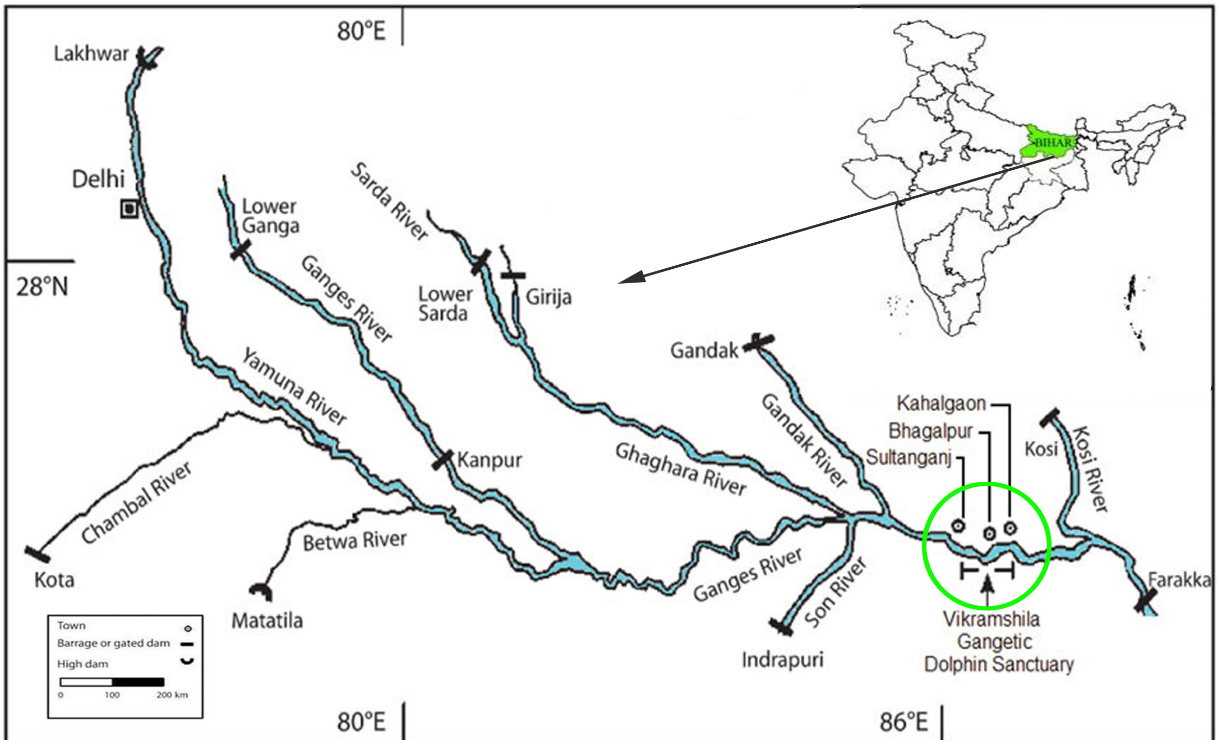

Fig -1: Location map of Vikramsila Gangetic Dolphin Sanctuary and the collection sites.

A
पर्यावरण एवं वन विभाग बिहार सरकार
डॉल्फीन की रक्षा गंगा की सुरक्षा
विक्रमशीला गांगेय डॉल्फीन आश्रयणी क्षेत्र सुलतानगंज
से कहलगाँव तक 60 कि.मी. का है/डॉल्फीन को पकड़ना या
मारना वन्य प्राणी संरक्षण अधिनियम (1972 के अन्तर्गत) जघन्य
अपराध है/ हम सब मिलकर डॉल्फीन (सोंस) की रक्षा करें/
बांका प्रमंडल बांका
B
C
D
E
F
G
H

Fig -2: Habitat photos of various collection sites of Vikramsila Gangetic Dolphin Sanctuary.

24 taxa of Chlorophyceae of 15 genera, 21 taxa of Bacillariophyceae of 16 genera, 5 taxa of Euglenophyceae belonging to 1 genus and one taxon each of Dinophyceae and Xanthophyceae. Out of these six algal taxa, e.g. *Aphanocapsa incerta* (Lemmerm.) Cornberg & Komárek, *Chroococcopsis epiphytica* Geitler, *Cosmarium ornatum* Ralfs ex Ralfs, *Euastrum verrucosum* Ehrenb. ex Ralfs var. *reductum* Nordst., *Navicula parietina* Kütz. and *Entomoneis alata* (Ehrenb.) Ehrenb. were reported as new distributional records from India. All the taxa are systematically

enumerated with morphometric descriptions along with their habitat informations. Illustrative photomicrographs of the algal species are given in Fig. 3 – 5.

CLASS – CYANOPHYCEAE

Aphanocapsa holsatica (Lemmerm.) Cornberg & Komárek, Arch. Hydrobiol. Suppl. 105 (Algol. Stud. 75): 333. 1994. *Clathrocystis holsatica* Lemmerm., Forschungsber. Biol. Stat. Plön 10: 150. 1903. (Family – Merismopediaceae) **(Fig. 3A)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur south, 67938, 26.12.2014

Aphanocapsa incerta (Lemmerm.) Cornberg & Komárek, Arch. Hydrobiol. Suppl. 105 (Algol. Stud. 75): 333. 1994. *Polycystis incerta* Lemmerm., Forschungsber. Biol. Stat. Plön 7: 132. 1899. (Family – Merismopediaceae) **(Fig. 3B)**

Spherical microscopic colonies with irregularly arranged cells; cells bright blue-green to yellowish green in colour; mucilage colourless and thin; cells almost spherical with aerotopes, 1.7-3.2 µm in diameter.

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Note: This taxon is a new record from India. This is a cosmopolitan taxon recorded from several countries of Europe, Asia, Australia, North & South America and also from Arctic.

Aphanocapsa litoralis Hansg., Sitzungsber. Königl. Böhm. Ges. Wiss. Prag, Math. –Naturwiss. Cl. 1892: 229. 1892. (Family – Merismopediaceae) **(Fig. 3 C)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Calothrix marchica Lemmerm. var. **intermedia** C.B. Rao, Proc. Indian Acad. Sc., sect. B, 6: 350. 1937. Family – Rivulariaceae) **(Fig. 3 L)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Chroococcopsis epiphytica Geitler, Plant Syst. & Evol. 136: 60. 1980. (Family –Xenococcaceae) **(Fig. 3 H)**

Aggregate of 10 cells attached to the *Oedogonium* filaments; cells arranged irregularly, blue-green in colour, sub-spherical, 2.5-7.3 µm long and 3.9-5.2 µm broad.

Mode of occurrence – epiphytic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Note: This taxon is a new record from India. Earlier recorded from Austria and Israel.

Chroococcus minutus (Kütz.) Nägeli, Gatt. Einzell. Alg.: 46. 1849. *Protococcus minutus* Kütz., Phyc. Gen.: 168. 1843. (Family – Xenococcaceae) **(Fig. 3 E)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Gloeocapsopsis pleurocapsoides (Nováček) Komárek & Anagnostidis, Arch. Hydrobiol. suppl. 73 (Algol. Stud. 43): 191. 1986. *Gloeocapsa pleurocapsoides* Nováček, Mohelnho 3a: 93. 1934. (Family – Chroococcaceae) **(Fig. 3 G)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Limnococcus limneticus (Lemmermann) Komárková, Jezberová, O.Komárek & Zapomelová, Hydrobiologia 639: 79. 2010. *Chroococcus limneticus* Lemmerm., Bot. Centralbl. 76: 153. 1898. (Family – Chroococcaceae) **(Fig. 3 F)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Merismopedia glauca (Ehrenb.) Kütz., Phyc. Germ.: 142. 1845. *Gonium glaucum* Ehrenb., Die Infusion. als vollkommene Organismen: 58. 1838. (Family – Merismopediaceae) **(Fig. 3 D)**

Mode of occurrence – planktonic.

Specimen examined: Kahalgaon, 67942, 29.12.2014; Jagatpur south-west, 67937, 26.12.2014; Jagatpur south, 67938

Phormidium calcicola N.L. Gardner, N.Y. Bot. Gard. 7: 33. 1927. (Family – Phormidiaceae) **(Fig. 3 K)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Pseudanabaena catenata Lauterborn, Verh. Natur.-Medi. Ver. Heidelberg, ser. 2, 13: 437. 1915. (Family – Pseudanabaenaceae) **(Fig. 3 J)**

Mode of occurrence – planktonic.

Specimen examined: Kahalgaon, 67942, 29.12.2014

Trichormus azollae (Strasburger) Komárek & Anagnostidis, Arch. Hydrobiol. suppl. 82 (Algol. Stud. 56): 303. 1989. *Anabaena azollae* Strasburger, Bot. Prakt. Ed. 1: 352. 1884. (Family – Rivulariaceae) **(Fig. 3 M)**

Mode of occurrence – Endophytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Xenococcus willei N.L.Gardner, Mem. N.Y. Bot. Gard. 7: 33. 1927. (Family – Xenococcaceae) **(Fig. 3 I)**

Mode of occurrence – epiphytic

Specimen examined: Jagatpur south, 67938, 26.12.2014

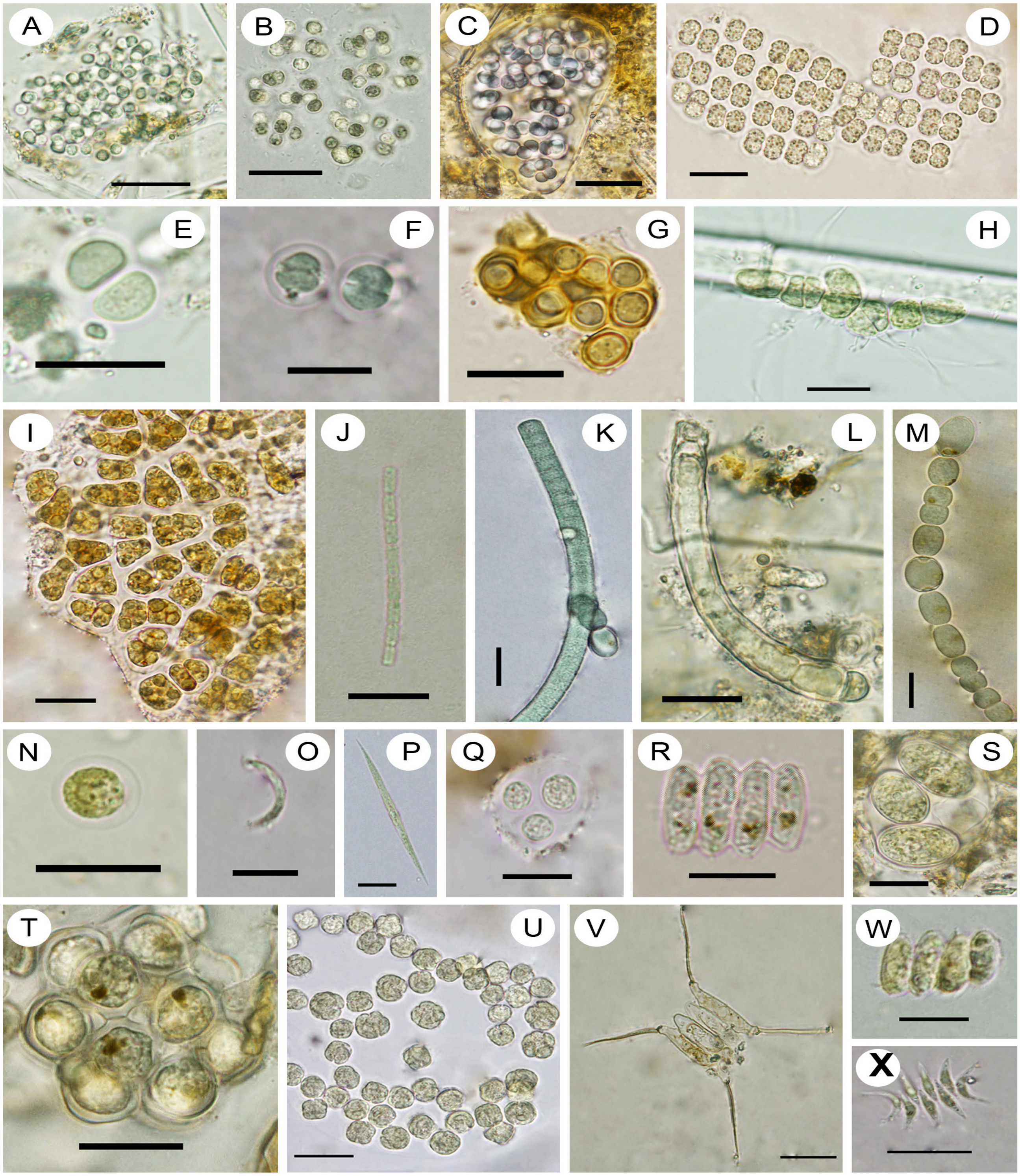

Fig -3: **A.** *Aphanocapsa holsatica*, **B.** *Aphanocapsa incerta*, **C.** *Aphanocapsa litoralis*, **D.** *Merismopedia glauca*, **E.** *Chroococcus minutus*, **F.** *Limnococcus limneticus*, **G.** *Gloeocapsopsis pleurocapsoides*, **H.** *Chroococcopsis epiphytica*, **I.** *Xenococcus willei*, **J.** *Pseudanabaena catenata*, **K.** *Phormidium calcicola*, **L.** *Calothrix marchica* var. *intermedia*, **M.** *Trichormus azollae*, **N.** *Sphaerellopsis mucosa*, **O.** *Monoraphidium circinale*, **P.** *Monoraphidium griffithii*, **Q.** *Granulocystis helenae*, **R.** *Desmodesmus aculeolatus*, **S.** *Oocystis parva*, **T.** *Coelastrum cambricum*, **U.** *Eudorina elegans*, **V.** *Desmodesmus protuberans*, **W.** *Desmodesmus microspina*, **X.** *Acutodesmus acuminatus* (Scale bar: A – U, W – X = 10 µm; V = 20 µm).

CLASS – CHLOROPHYCEAE

Acutodesmus acuminatus (Lagerh.) Tsarenko, Algologia 10: 176. 2000. *Selenastrum acuminatum* Lagerh., K. Svenska Vet. –Akad. Förh. 39: 71. 1882. (Family – Scenedesmaceae) **(Fig. 3 X)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Closterium aciculare West, Trans. Micr. Soc. London, ser. 2, 8: 153 1860. (Family – Desmidiaceae) **(Fig. 4 K)**

Mode of occurrence – benthic

Specimen examined: Nathnagar, near Bhagalpur, 67941, 28.12.2014

Closterium parvulum Nägeli, Gatt. Einzell. Alg.: 106. 1849. (Family – Desmidiaceae) **(Fig. 4 L)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur south, 67938, 26.12.2014

Coelastrum cambricum Archer, Quart. J. Micr. Sc., ser. 2, 8: 65. 1868. (Family – Coelastraceae) **(Fig. 3 T)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Cosmarium ornatum Ralfs ex Ralfs, Ann. Mag. Nat. Hist. 14: 392. 184. 1989. (Family – Desmidiaceae) **(Fig. 4 M)**

Cells solitary, semicells reniform, with undulate margins, cell wall ornamented with small granules, 12.2-14.8 µm long and 23.6-25.5 µm broad, chloroplast one per each semicell, axial, with distinct nucleus towards the isthmus.

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Note: This taxon is a new record from India. Earlier recorded from Brazil, Russia and several coutries of Europe.

Cosmarium rectangulare Grunow, Fl. Eur. Alg. 3. 166. 1868. (Family – Desmidiaceae) **(Fig. 4 Q)**

Mode of occurrence – planktonic

Specimen examined: Kahalgaon, 67942, 29.12.2014

Desmodesmus aculeolatus (Reinsch) Tsarenko, Algologia 10: 278. 2000. *Scenedesmus aculeolatus* Reinsch, J. Linn. Soc., London Bot. 16: 238. 1877. (Family – Scenedesmaceae) **(Fig. 3 R)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Desmodesmus microspina (Chodat) Tsarenko, Algologia 10: 289. 2000. *Scenedesmus microspina* Chodat, Z. Hydrol. 3: 232. 1926. (Family – Scenedesmaceae) **(Fig. 3 W)**

Mode of occurrence – planktonic.

Specimen examined: Kahalgaon, 67942, 29.12.2014

Desmodesmus protuberans (Fritsch & Rich) Hegewald, Arch. Hydrobiol. Suppl. 131 (Algol. Stud. 96): 16. 2000. *Scenedesmus protuberans* Fritsch & Rich, Trans. Roy. Soc. South Africa 18: 31. 1929. (Family – Scenedesmaceae) **(Fig. 3 V)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Euastrum verrucosum Ehrenb. ex Ralfs var. **reductum** Nordst., Lunds Univ. Årsskr. 16, Afd. Math. –Natur. 4: 9. 1880. (Family – Desmidiaceae) **(Fig. 4 N)**

Cells solitary, oval in outline, semicells 3 lobed on either side, with shallow apical notch; sinus deep, closed and linear; margin slightly undulate with superficial protrubances; semicells 28.6-30.3 µm broad and 22.5-23.5 µm long, isthmus 8.6 µm broad.

Mode of occurrence – planktonic

Specimen examined: Kahalgaon, 67942, 29.12.2014

Note: This taxon is a new record from India. Earlier recorded from Romania and Russia.

Eudorina elegans Ehrenb., Abh. K. Akad. Wiss. Berlin Phys. Kl. 1831: 78. 1832. (Family – Volvocaceae) **(Fig. 3 U)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur south, 67938, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Granulocystis helenae Hindák, Biol. Práce 23: 72. 1977. (Family – Oocystaceae) **(Fig. 3 Q)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Monoraphidium circinale (Nygaard) Nygaard, Bot. Tidsskr. 73: 212. 1979. *Monoraphidium capricornutum* (Printz) Nygaard var. *circinale* Nygaard, K. Danske Vid. Selsk., Biol. Skr. 21: 60. 1977. (Family – Chlorellaceae) **(Fig. 3 O)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Monoraphidium griffithii (Berkeley) Komárková-Legnerová, Stud. Phyc.: 98. 1969. *Closterium griffithii* Berkeley, Ann. Mag. Nat. Hist., ser. 2, 13: 256. 1854. (Family – Chlorellaceae) **(Fig. 3 P)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Mougeotia laetevirens (A. Braun) Wittrock, Bot. Not. 1877: 23. 1877. *Craterospermum laetevirens* A. Braun, Alg. Unicell.: 60. 1855. (Family – Zygnemataceae) **(Fig. 4 B)**

Mode of occurrence – floating

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur south, 67938, 26.12.2014

Oedogonium capitellatum Wittrock, Nova Acta R. Soc. Sc. Upsal., ser. 3, 9: 7. 1874. (Family – Oedogoniaceae) **(Fig. 4 A)**

Mode of occurrence – epiphyic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur south, 67938, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Oocystis parva West & G.S. West, J. Bot. (London) 36: 335. 1898. (Family – Oocystaceae) **(Fig. 3 S)**

Mode of occurrence – epiphytic

Specimen examined: Jagatpur south, 67938, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Sphaerellopsis mucosa (Pascher) Pentecost, Freshw. Alg. Fl. British Isles: 324. 2002. *Chlamydomonas mucosa* Pascher, Süssw. –Fl. 4: 296. 1927. (Family – Chlamydomonadaceae) **(Fig. 3 N)**

Mode of occurrence – epiphytic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Spirogyra affinis (Hassall) Petit, Spir. Paris: 18. 1880. *Zygnema affine* Hassall, Brit. Freshw. Alg. 1: 155. 1845. (Family – Zygnemataceae) **(Fig. 4 C)**

Mode of occurrence – floating

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Spirogyra ellipsospora Transeau, Amer. J. Bot. 1: 294. 1914. (Family – Zygnemataceae) **(Fig. 4 D)**

Mode of occurrence – floating

Specimen examined: Sultanganj ghat, 67939, 27.12.2014

Spirogyra hyalina Cleve, Nova Acta Reg. Soc. Sc. Upsal. Ser. 3, 6: 13. 1868. (Family – Zygnemataceae) **(Fig. 4 E-F)**

Mode of occurrence – floating

Specimen examined: Jagatpur north-west, 67936, 26.12.2014; Jagatpur south, 67938, 26.12.2014; Sultanganj ghat, 67939, 27.12.2014

Spirogyra longata (Vaucher) Kützing, Phyc. Gen.: 279. 1843. *Conjugata longata* Vaucher, Hist. Conf.: 71. 1803. (Family – Zygnemataceae) **(Fig. 4 G-H)**

Mode of occurrence – floating

Specimen examined: Kahalgaon, 67942, 29.12.2014

Spirogyra submaxima Transeau, Amer. J. Bot. 1: 295. 1914. (Family – Zygnemataceae) **(Fig. 4 I)**

Mode of occurrence – floating

Specimen examined: Kahalgaon, 67942, 29.12.2014

Zygnema gangeticum C.B. Rao, J. Indian Bot. Soc. 16: 270. 1937. (Family – Zygnemataceae) **(Fig. 4 J)**

Mode of occurrence – floating

Specimen examined: Jagatpur south, 67938, 26.12.2014

CLASS – EUGLENOPHYCEAE

Trachelomonas abrupta Swirenko, Arch. Hydrobiol. 9: 638. 1914. (Family – Euglenaceae) **(Fig. 4 R)**

Mode of occurrence – planktonic

Specimen examined: Kahalgaon, 67942, 29.12.2014

Trachelomonas bacillifera Playfair **var. globulosa** Playfair, Proc. Linn. Soc. N.S.W. 46: 132. 1921. (Family – Euglenaceae) **(Fig. 4 O)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur south, 67938, 26.12.2014

Trachelomonas hispida (J.A.M. Pery) F. Stein var. **duplex** Deflandre, Rev. Gen. Bot. 38: 652. 1926. (Family – Euglenaceae) **(Fig. 4 S)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Trachelomonas volvocina (Ehrenb.) Ehrenb. var. **volvocina**, Abh. K. Akad. Wiss. Berlin, Physik. Kl. 1833: 315. 1834. *Microglena volvocina* Ehrenberg, Abh. K. Akad. Wiss. Berlin, Physik. Kl. 1831: 64. 1832. (Family – Euglenaceae) **(Fig. 4 P)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Trachelomonas volvocina (Ehrenb.) Ehrenb. var. **punctata** Playfair, Proc. Linn. Soc. N.S.W. 46: 129. 1921. (Family – Euglenaceae) **(Fig. 4 T)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur south, 67938, 26.12.2014

CLASS – DINOPHYCEAE

Chimonodinium lomnickii (Woloszynska) Craveiro, Calado, Daugbjerg, Hansen & Moestrup, Protist 162: 605. 2011. *Peridinium lomnickii* Woloszynska, Bull. Int. Acad. Sc. Cracovie, Cl. Sc. Math. et Nat., ser. 8, 1915: 267. 1916. (Family – Thoracosphaeraceae) **(Fig. 5 D)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

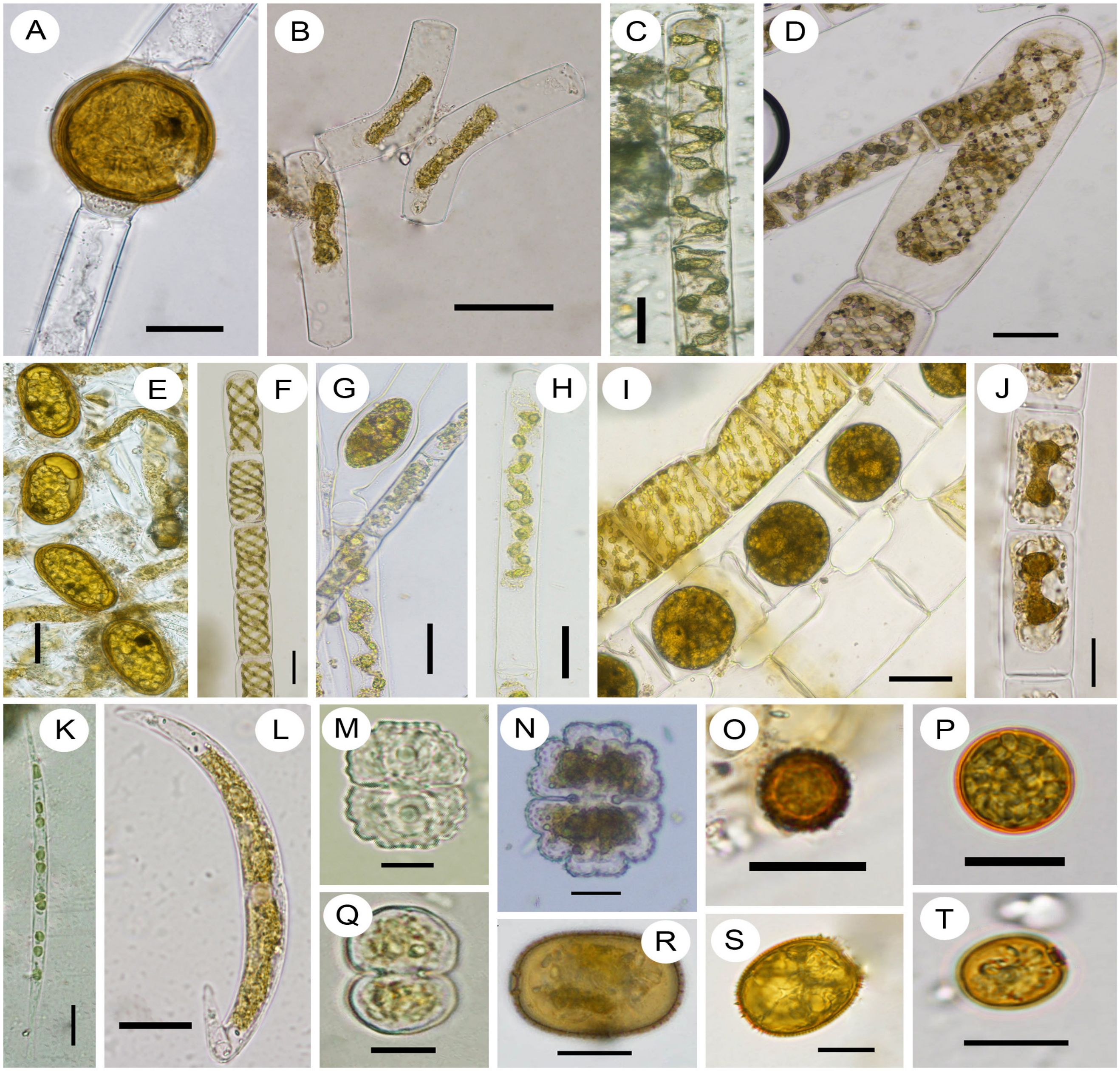

Fig -4: **A.** *Oedogonium capitellatum*, **B.** *Mougeotia laetevirens*, **C.** *Spirogyra affinis*, **D.** *Spirogyra ellipsospora*, **E-F.** *Spirogyra hyalina*, **G-H.** *Spirogyra longata*, **I.** *Spirogyra submaxima*, **J.** *Zygnema gangeticum*, **K.** *Closterium aciculare*, **L.** *Closterium parvulum*, **M.** *Cosmarium ornatum*, **N.** *Euastrum verrucosum* var. *reductum*, **O.** *Trachelomonas bacillifera* var. *globulosa*, **P.** *Trachelomonas volvocina* var. *volvocina*, **Q.** *Cosmarium rectangulare*, **R.** *Trachelomonas abrupta*, **S.** *Trachelomonas hispida* var. *duplex*, **T.** *Trachelomonas volvocina* var. *punctata* (Scale bar: M, O – T = 10 µm; A, C – L, N = 20 µm; B = 50 µm)

CLASS – XANTHOPHYCEAE

Ophiocytium cochleare (Eichw.) A. Braun, Alg. Unicell.: 54. 1855. *Spirodiscus cochlearis* Eichw., Bull. Soc. Imp. Nat. Moscou 20: 301. 1847. (Family – Ophiocytiaceae) **(Fig. 5 A)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

CLASS – BACILLARIOPHYCEAE

Achnanthidium minutissimum (Kütz.) Czarnecki, Proc. Int. Diatom Symp. 11: 157. 1994. *Achnanthes*

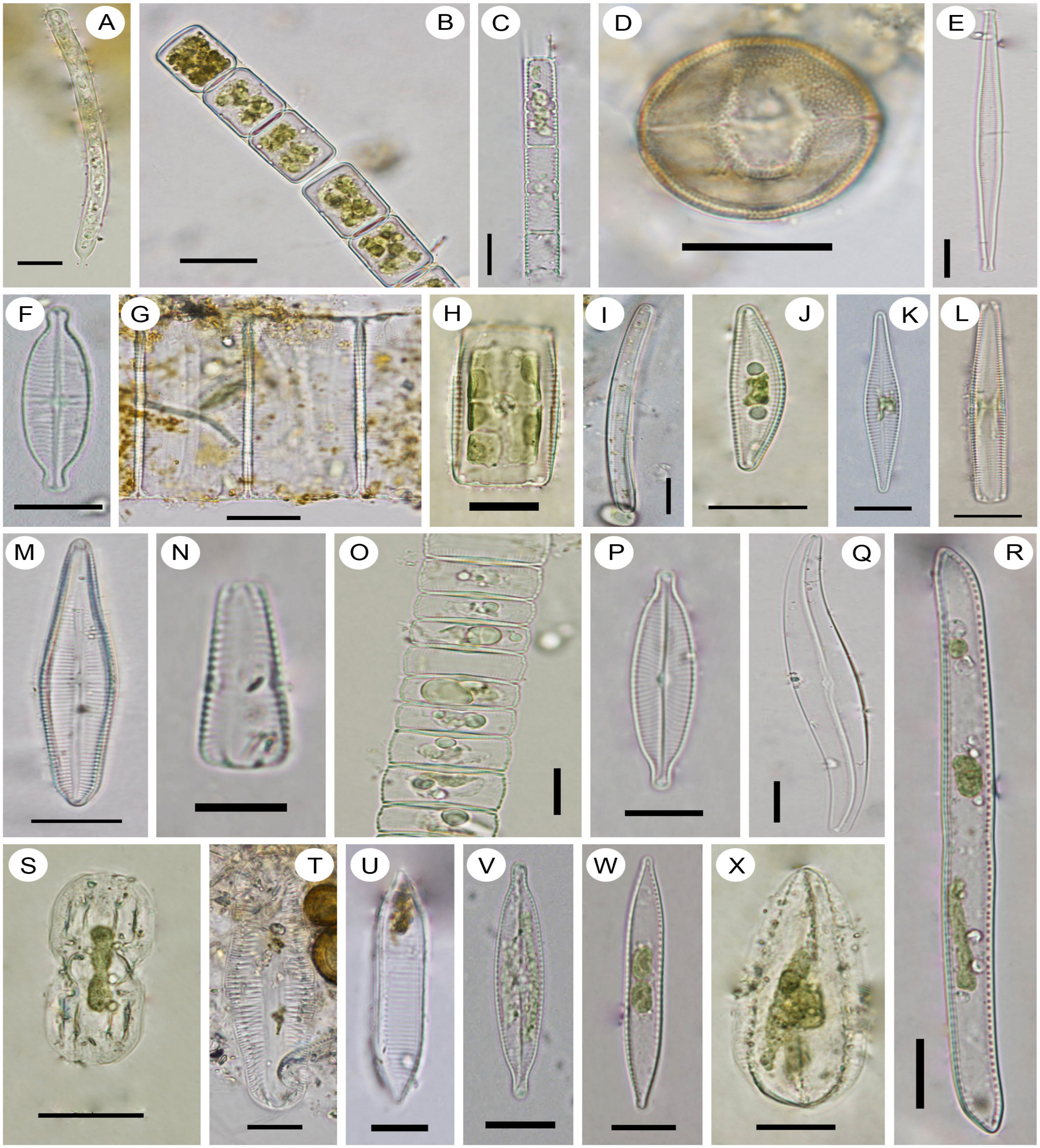

Fig -5: **A.** *Ophiocytium cochleare*, **B.** *Melosira varians*, **C.** *Aulacoseira alpigena*, **D.** *Chimonodinium lomnickii*, **E.** *Fragilaria gracilis*, **F.** *Achnanthidium minutissimum*, **G.** *Fragilariforma virescens*, **H.** *Diatoma hyemalis*, **I.** *Eunotia bilunaris*, **J.** *Cymbella affinis*, **K.** *Gomphonema affine*, **L-M.** *Gomphonema gracile*, **N.** *Gomphonema minutum*, **O.** *Diadesmis confervacea*, **P.** *Navicula cryptocephala*, **Q.** *Pleurosigma angulatum*, **R.** *Nitzschia obtusa*, **S.** *Navicula parietina*, **T.** *Entomoneis alata*, **U.** *Rhopalodia gibba*, **V.** *Nitzschia amphibia*, **W.** *Nitzschia recta*, **X.** *Surirella robusta* (Scale bar: A, C, F – Q, T – X = 10 µm; B, D – E, R – S = 20 µm) *minutissima* Kütz., Alg. Aq. Dulc. Germ. 8: 4. 1834. (Family – Achnanthidiaceae) **(Fig. 5 F)**

Mode of occurrence – planktonic, benthic

Specimen examined: Kahalgaon, 67942, 29.12.2014; Nathnagar, near Bhagalpur, 67941, 28.12.2014; Jagatpur north-west, 67936, 16.12.2014; Jagatpur south, 67938, 26.12.2014

Aulacoseira alpigena (Grunow) Krammer, Nova Hedwigia 52: 93. 1991. *Melosira distans* var. *alpigena* Grunow, Syn. Diat. Belgique, pl. 86: 28. 1882. (Family – Aulacoseiraceae) **(Fig. 5 C)**

Mode of occurrence – benthic, planktonic

Specimen examined: Nathnagar, near Bhagalpur, 67941, 28.12.2014; Jagatpur north-west, 67936, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Cymbella affinis Kütz., Bacillarien: 80. 1844. (Family – Cymbellaceae) **(Fig. 5 J)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Diadesmis confervacea Kütz., Bacillarien: 109. 1844. (Family – Diadesmidiaceae) **(Fig. 5 O)**

Mode of occurrence – epiphytic, benthic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur north, 67935, 26.12.2014

Diatoma hyemalis (Roth) Heiberg, Conspect. Diatom Dan.: 58. 1863. *Conferva hyemalis* Roth, Tent. Fl. Germ. 3: 506. 1800. (Family – Tabellariaceae) **(Fig. 5 H)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Entomoneis alata (Ehrenb.) Ehrenb., Ber. K. Akad. Wiss. Berlin 1845: 154. 1845. *Navicula alata* Ehrenb., Ber. K. Akad. Wiss. Berlin 1840: 212. 1840. (Family – Entomoneidaceae) **(Fig. 5 T)**

Cells dumbbell shaped, 47.4-52.4 µm long and 15.9-18.5 µm broad; raphe sigmoid along a narrow ridge; cells with single, slightly bilobed, central plastid.

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Note: This taxon is a new record from India, though cosmopolitan in distribution in other parts of the globe.

Eunotia bilunaris (Ehrenb.) Schaarschmidt, Kanitz, Pl. Roman.: 159. 1880. *Synedra bilunaris* Ehrenb., Abh. K. Akad. Wiss. Berlin Phys. Kl. 1831: 87. 1832. (Family – Eunotiaceae) **(Fig. 5 I)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Fragilaria gracilis Østrup, Danske Diat.: 190. 1910. (Family – Fragilariaceae) **(Fig. 5 E)**

Mode of occurrence – epiphytic, benthic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur south, 67938, 26.12.2014; Sultanganj ghat, 67939, 27.12.2014

Fragilariforma virescens (Ralfs) Williams & Round, Diat. Res. 3: 265. 1988. *Fragilaria virescens* Ralfs, Ann. Mag. Nat. Hist. 12: 110. 1843. (Family – Fragilariaceae) **(Fig. 5 G)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north, 67935, 26.12.2014

Gomphonema affine Kütz., Bacillarien: 86. 1844. (Family – Gomphonemataceae) **(Fig. 5 K)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014

Gomphonema gracile Ehrenb., Infusionsthierchen: 217. 1838. (Family – Gomphonemataceae) **(Fig. 5 L-M)**

Mode of occurrence – epiphytic, benthic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur south, 67938, 26.12.2014; Jagatpur north, 67935, 26.12.2014

Gomphonema minutum (C. Agardh) C. Agardh, Consp. Crit. Diat.: 34. 1831. *Licmophora minuta* C. Agardh, Flora 10: 629. 1827. (Family – Gomphonemataceae) **(Fig. 5 N)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur north-west, 67936, 26.12.2014

Melosira varians C. Agardh, Flora 10: 628. 1827. (Family – Melosiraceae) **(Fig. 5 B)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Navicula cryptocephala Kütz., Bacillarien: 95. 1844. (Family – Naviculaceae) **(Fig. 5 P)**

Mode of occurrence – benthic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Navicula parietina Kütz., Bacillarien: 103. 1844. (Family – Naviculaceae) **(Fig. 5 S)**

Valves linear, lanceolate, ends obtuse to broadly rounded, 33.8-35.2 µm long and 6.9-8.1 µm broad; raphe lateral; striae radiate, convergent at the ends, 14-16 in 10 µm.

Mode of occurrence – planktonic

Specimen examined: Jagatpur south-west, 67938, 26.12.2014

Note: This taxon is a new record from India. Earlier reported from Europe and United States of America.

Nitzschia amphibia Grunow, Verh. K. Zool.-Bot. Ges. Wien 12: 574. 1862. (Family – Bacillariaceae) **(Fig. 5 V)**

Mode of occurrence – benthic

Specimen examined: Sultanganj ghat, 67939, 27.12.2014

Nitzschia obtusa W. Sm., Syn. Brit. Diat. 1: 39. 1853. (Family – Bacillariaceae) **(Fig. 5 R)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Nitzschia recta Hantzsch ex Rabenh., Alg. Eur.: 1283. 1862. (Family – Bacillariaceae) **(Fig. 5 W)**

Mode of occurrence – benthic

Specimen examined: Nathnagar, near Bhagalpur, 67941, 28.12.2014; Jagatpur north-west, 67936, 26.12.2014

Pleurosigma angulatum (Queckett) W. Sm., Ann. Mag. Nat. Hist., ser. 2, 9: 7. 1852. *Navicula angulata* Queckett, Treat. Microscope: 438. 1848. (Family – Pleurosigmataceae) **(Fig. 5 Q)**

Mode of occurrence – benthic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Rhopalodia gibba (Ehrenb.) O. Müller, Bot. Jahrb., 22: 65. 1895. *Navicula gibba* Ehrenb., Abh. Königl. Akad. Wiss. Berlin, Phys. Kl. 1830: 64. 1830. (Family – Rhopalodiaceae) **(Fig. 5 U)**

Mode of occurrence – epiphytic

Specimen examined: Sultanganj, 67940, 27.12.2014; Jagatpur north, 67935, 26.12.2014

Surirella robusta Ehrenb., Ber. K. Akad. Wiss. Berlin 1842: 337. 1842. (Family – Surirellaceae) **(Fig. 5 X)**

Mode of occurrence – planktonic

Specimen examined: Jagatpur north-west, 67936, 26.12.2014

Benthic algal assemblages in riverine ecosystems remained stable through out the downstream of the water. On contrary, the phytoplankton and periphyton change with variations in the hydrochemistry and nutrient status of the water (Stevenson & al. 1996). Repetative occurrence of diatom taxa, *e.g. Aulacoseira alpigena*, *Achnanthidium minutissimum*, *Fragillaria gracilis*, *Gomphonema gracile*, *Rhopalodia gibba* and *Nitzschia recta* in more than one locality indicated stability of benthic algal communities. Difference in planktonic populations was not observed might be due to the low water flow in the river during winter. Lack of commonality of taxa between the collection sites of Sultanganj and Kahalgaon was found, inferring floristic change along the 60 km long riverine course of the protected area. Maximum number of taxa was recorded in near Jagatpur and Bhagalpur cities located in the middle of the sanctuary. Hence the algal richness in these sites was possibly due to organic loading as a result of anthropogenic activities.

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